

A Modular Re-configurable Rover System

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In this paper we present the novel concepts incorporated in a planetary surface exploration rover design that is currently under development. The Multitasking Rover (MTR) aims to demonstrate functionality that will cover many of the current and future needs such as rough-terrain mobility, modularity and upgradeability [1]. The rover system has enhanced mobility characteristics. It operates in conjunction with Science Packs (SPs) and Tool Packs (TPs) – modules attached to the main frame of the rover, which are either special tools or science instruments and alter the operation capabilities of the system.

To date, each rover system design is very much task driven for example, the scenario of cooperative transportation of extended payloads [2], comprises two rovers each equipped with a manipulator dedicated to the task [3]. The MTR approach focuses mostly on modularity and upgradeability presenting at the same time a fair amount of internal re-configurability for the sake of rough terrain stability. The rover itself does not carry any scientific instruments or tools. To carry out the scenario mentioned above, the MTR would have to locate and pick-up a TP with the associated manipulator. After the completion of the task the TP could be put away to a storage location enabling the rover to utilize a different Pack. The rover will not only offer mobility to these modules, but also use them as tools, transforming its role and functionality. The advantage of this approach is that instead of sending a large number of rovers to perform a variety of tasks, a smaller number of MTRs could be deployed with a large number of SPs/TPs, offering multiples of the functionality at a reduced payload. Two SPs or TPs (or a combination of) can be carried and deployed.

One of the key elements in the design of the four wheeled rover, lies within its suspension system. It comprises a linear actuator located within each leg and also an active differential linking the two shoulders. This novel design allows the MTR to lift, lower, roll or tilt its body. It also provides the ability to lift any of the legs by nearly 300mm, enhancing internal re-configurability and therefore rough terrain stability off the robotic vehicle.

A modular software and control architecture will be used so that integration to, and operation through the MTR, of different Packs can be demonstrated. An on-board high-level controller [4] will communicate with a small network of micro-controllers through an RS485 bus. Additional processing power could be obtained through a Pack with equivalent or higher computational capabilities.

The nature of the system offers many opportunities for behavior based control. The control system must accommodate not only rover based behaviors like obstacle avoidance and vehicle stabilization, but also any additional behaviors that different Packs may introduce. The Ego-Behavior Architecture (EBA) [5] comprises a number of behaviors which operate autonomously and independent of each other. This facilitates the design and suits the operation of the MTR since it fulfills the need for uncomplicated assimilation of new behaviors in the existing architecture.

Our work at the moment focuses on the design and construction of the mechanical and electronic systems for the MTR and an associated Pack.

References

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